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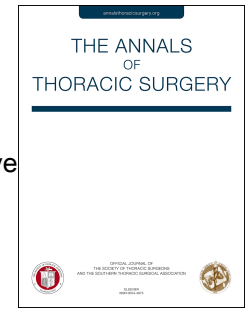

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Fracture of a Transcatheter Atrial Septal Defect Occluder Device Causing Mitral Valve Perforation

Running Head: A Case of an ASD Occluder Failure

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Abstract

Transcatheter atrial septal defect (ASD) device closure has gained increasing popularity over the past decades due to shorter hospital stay and the absence of skin scars. However, concern about the seriousness of device-related complications is accumulating. We report a case of device fracture in a young asymptomatic woman almost 4 years after percutaneous secundum ASD closure, resulting in mitral valve perforation. Subsequently, elective surgical removal of the device and mitral valve reconstruction was performed. This case demonstrates that complications from transcatheter ASD closure may even occur late after implantation.

Word count: 89

Over the past decades, transcatheter device closure has become first choice in the treatment of secundum atrial septal defects (ASD) if morphology is feasible [1]. Although many studies have shown high rates of successful closure, there is accumulating concern about the seriousness of device-related complications even years after device deployment, including fatalities or serious events requiring salvage surgery [2-4]. This supports the recommendation that such patients should remain under permanent surveillance to observe potentially serious long-term complications [3].

Here, we report an ATRIASEPT II device (Version 2008, Cardia Inc., Eagan, MN, USA) fracture almost 4 years after percutaneous secundum ASD closure, associated with subsequent mitral valve perforation and regurgitation that required surgical repair. For the review of clinical records and the publication of this case, an informed consent was obtained from the patient.

A 19-year-old female underwent endovascular secundum ASD closure at the age of 16 years. Closure was successfully performed using a 22mm ATRIASEPT II occluder (version 2008, Cardia Inc., Eagan, MN, USA), a double-disk-device offering a low-profile conformation to the septum.

At routine control almost 4 years after implantation, transthoracic echocardiography revealed a fractured arm of the ATRIASEPT II device. Since the fracture occurred in one of the inferior arms, the strut protruded in antero-inferior direction and came into direct contact with the anterior leaflet of the mitral valve (segment A2) **(Fig. 1a, 1b)**. Echocardiography showed the strut in the A2 segment of the mitral valve causing a minimal mitral insufficiency (1/4) in the posteromedial commissure at the basis of the posteromedial segment P3 **(Fig. 1c)**. During ventricular systole, the anterior leaflet folded around the strut. The device was still effective in occluding the former ASD without residual shunt. There were no other pathological findings in echocardiography, the other valves as well as right and left (EF 74%) ventricular pump function were normal.

Owing to the lesions of the mitral valve, elective surgical removal of the device was indicated. Following midaxillary thoracotomy in the 4th intercostal space, total cardiopulmonary bypass was set up through the femoral vessels. The right atrium was opened and the device was found to be only partially endothelialized. Due to the proximity to the atrioventricular node, device removal was a delicate process. After the device was removed and the left atrium was inspected through the open ASD, a remaining strut was identified perforating the anterior leaflet of the mitral valve **(Fig. 2)**. The strut was removed and the two mitral valve perforations, one in the anterior (A2) and one in the posterior (P3) leaflet, were repaired by direct suture. The septum was closed using an autologous pericardial patch. After weaning from bypass, echocardiographic reassessment showed a sufficient patch closure of the ASD without residual shunt and a good mitral valve function with minimal regurgitation towards the posteromedial commissure. The postoperative course was uneventful without the development of an atrioventricular block. The patient was discharged 4 days after surgery and recovered rapidly.

Comment

Our case demonstrates a fracture of an ATRIASEPT II (version 2008, Cardia Inc., Eagan, MN, USA) septal occluder device with subsequent mitral valve perforation requiring surgical intervention. While in the case presented here the fracture was located in a favorable inferior position, resulting in asymptomatic mitral valve perforation, reports of other cases of ATRIASEPT device fractures show possible fatal consequences such as aortic root perforation [5,6]. In contrast to its precursors, the ATRIASEPT II device presents an improved left atrial sail. Six wires in parabolic shape make up the skeleton for a circular sail and eliminate pointed arm tips while preventing a prolapse of the sail.

However, in the case presented here, it was exactly one of the parabolic wires that fractured, leading to the perforations of the mitral valve. As the strut was made of nitinol, a metal known

for its ability to return to its “memory shape”, the tension inside the occluder device was maintained over the years and, once fractured, caused a protrusion of the arm towards the mitral valve.

The initial cause of the strut fracture is difficult to identify. Physical strain on the device would be a plausible explanation if the fracture was located near the aortic root and the device would have shown a protrusion into or a splaying around the aortic root. But since the fracture was located inferiorly, strain-induced fracture is less likely. Assuming that the device remained in correct position, it is more likely that the constant tension within the parabolic arms of the device eventually resulted in a fracture. The partial endothelization of the device certainly contributed to the fact that the strut was able to unfold freely. Remarkably, all ATRIASEPT device fractures reported in the literature occurred late between 3 months and 4 years after implantation, similar to the case reported here, rather than directly after intervention [5,6].

Conclusion

This case report displays that endovascular ASD closure with the ATRIASEPT II occluder may result in device fracture with associated perforation of surrounding cardiac structures. The possibly fatal complications may occur late after implantation, even when the device is in correct position. Close monitoring is recommended for fractures of the parabolic left atrial struts and for subsequent perforations which might trigger endocarditis and thromboembolic events. The case presented here also demonstrates that even 4 years after implantation device endothelization may still be incomplete.

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Figure Legends

Figure 1: (a) Transthoracic echocardiography demonstrating the fractured strut protruding in antero-inferior direction and coming into contact with the anterior leaflet of the mitral valve. (b) Transthoracic 3D echocardiography displaying the fractured ATRIASEPT II septal occluder in loco typico. The fractured arm is protruding anteroinferiorly towards the valvular plane and coming into contact with the anterior leaflet of the mitral valve. (c) Duplex echocardiography during systole showing minimal mitral insufficiency.

Asterisk: Fractured arm of the device, De: ATRIASEPT II Device, LA: Left Atrium.

Figure 2: Intraoperative view of the ATRIASEPT II device after left atriotomy. The fractured and only partly endothelialized left atrial strut of the device is shown perforating the anterior leaflet (A2) of the mitral valve.